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Multiplexed Systems for NIF Optics Damage Inspection and Laser Precision Diagnostics

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Abstract

The National Ignition Facility (NIF) is a 192 beam laser system for ICF applications which is currently being designed for the US Department of Energy. A number of diagnostic systems are multiplexed, one beamline at a time being instrumented, because some high performance diagnostic systems are too expensive to replicate 192 times. Optics damage inspection and precision diagnostics are two such shared systems planned for NIF.

The beamlines are tightly packed in 4 high by 12 wide arrays (or clusters) with two such clusters side by side in each laser bay and switchyard. In each switchyard at the end of the laser chain a roving mirror is remotely placed in one of the beamlines to direct that laser beam through a relay path to the precision diagnostic station or to the optics inspection imaging system. The relay path contains a "trombone" or variable length path which permits matching the distance to the diagnostic with the distance to the frequency conversion crystals at the target chamber. An identical Final Optics Assembly (FOA) containing the frequency conversion crystals and target focus lens is included in the precision optics design.

In addition to measuring energy, high-temporal resolution power, and spectra, the precision diagnostics records near and far field images on full-power laser shots on one beam at a time at 1ω, 2ω and 3ω. The 3ω diagnostics measure the performance of the selected 1ω beam with the FOA installed on the precision diagnostics. This suite of diagnostics will be an essential tool during the initial activation phase of the laser and later during operation to do trouble shooting and for special studies.

Periodically, one beam at a time is directed to the optics inspection system. Here, dark field or Schlieren images of damage spots are imaged on a high-resolution CCD camera. Each beamline contains nearly 40 individual optical elements in the full aperture (40 cm by 40 cm) main laser; a total of more than 7500 large optics. Image processing software will characterize the size and locations of spots in the images and associate them with specific optics in the chains. Optics replacement decisions will be based on these measurements.

The precision diagnostic, optics inspection system, and roving mirror and relay path optics will be presented in the talk.

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